

THE USE OF ORGANIC HUMECTANTS AS NON-CORROSIVE DUST CONTROL AGENTS

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Development of Aldonic Acid Derivatives Designed for Dust Control

- **Problem:** Dust from roads and runways cause corrosion and wear on vehicles and aircraft that must be used in dusty environments.
- **Approach:** Use environmentally-friendly, non-toxic, non-corroding, water-based hydrogel to contain particulate agents
- **Method:** Prepare and evaluate organic moisture-collecting compounds based on aldonic acid (sugar-derived) hydrogel that are effective, safe and durable



Dust is both a corrosion and a safety problem.

Aldonic Hydrogels - Optimum Dust Control Agents

- Hydrogels are strongly hygroscopic and maintain a moist surface that can hold fugitive dust
- As the moisture level decreases the hydrogel develops a solid surface that can rehydrate and hold any fine particulates touching the surface
- Hydrogels do not support the rapid growth of mold or bacteria
- Hydrogels will not leach down into the lower soil layers



Lab sample of Vicksburg Loess treated with lactobionic acid after months in the laboratory

Hydrogels - Non-Toxic and Environmentally-Friendly



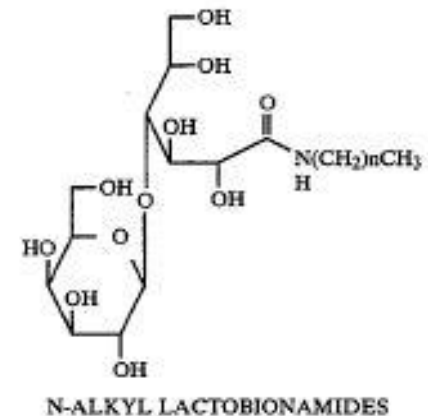
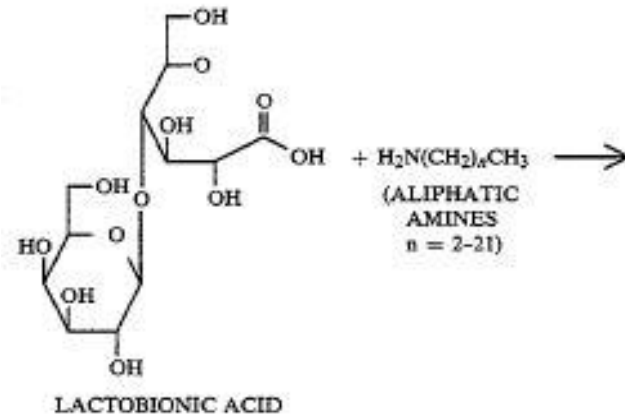
Rye grass on the left is growing in soil treated with a 25% lactobionic acid solution. The application produced a 10-day delay in wilting when no water was applied to the test plants.

- Lactobionic acid, an easily synthesized hydrogel, is used as a food additive and is a suspension agent used in pharmaceutical preparations where a suspension agent is needed
- Tests with rye grass indicate the hydrogel in soil does not inhibit plant growth
- Root clusters concentrate in the soil treated with hydrogel because the gel concentrates moisture in the treated layer at the top of the soil column
- Gel enhances the growth of root hairs and reduces the tendency of the plant to wilt when water is not applied

Adaptation of Aldonic Acids

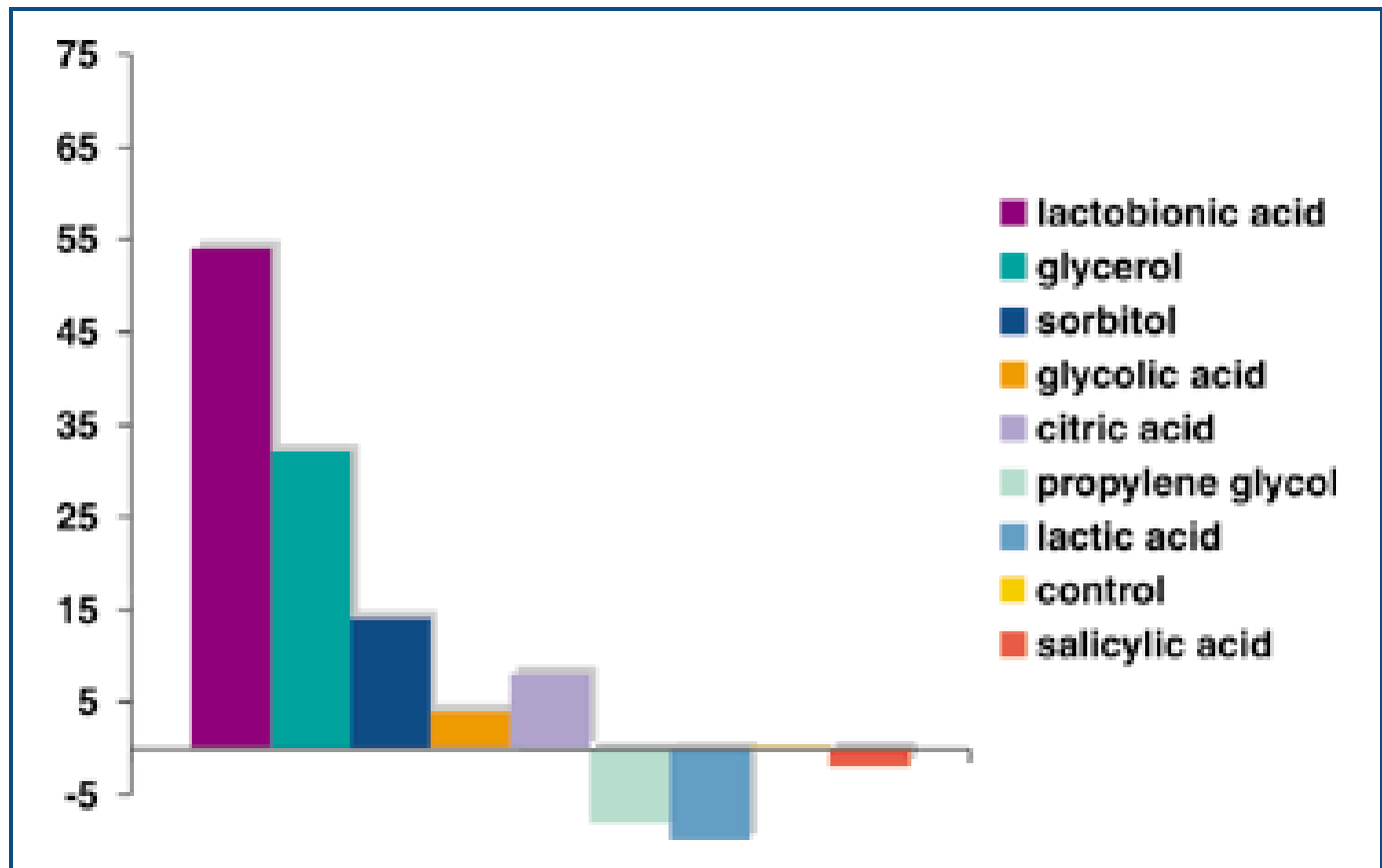
- Aldonic acids, lactobionic acid and maltobionic acid can be chemically modified to form surfactants that bond more firmly to soil

- Mixtures of hydrogel and surfactants moieties may be best for capturing and holding dust particles



Comparison of Water Retention for Organic Humectants

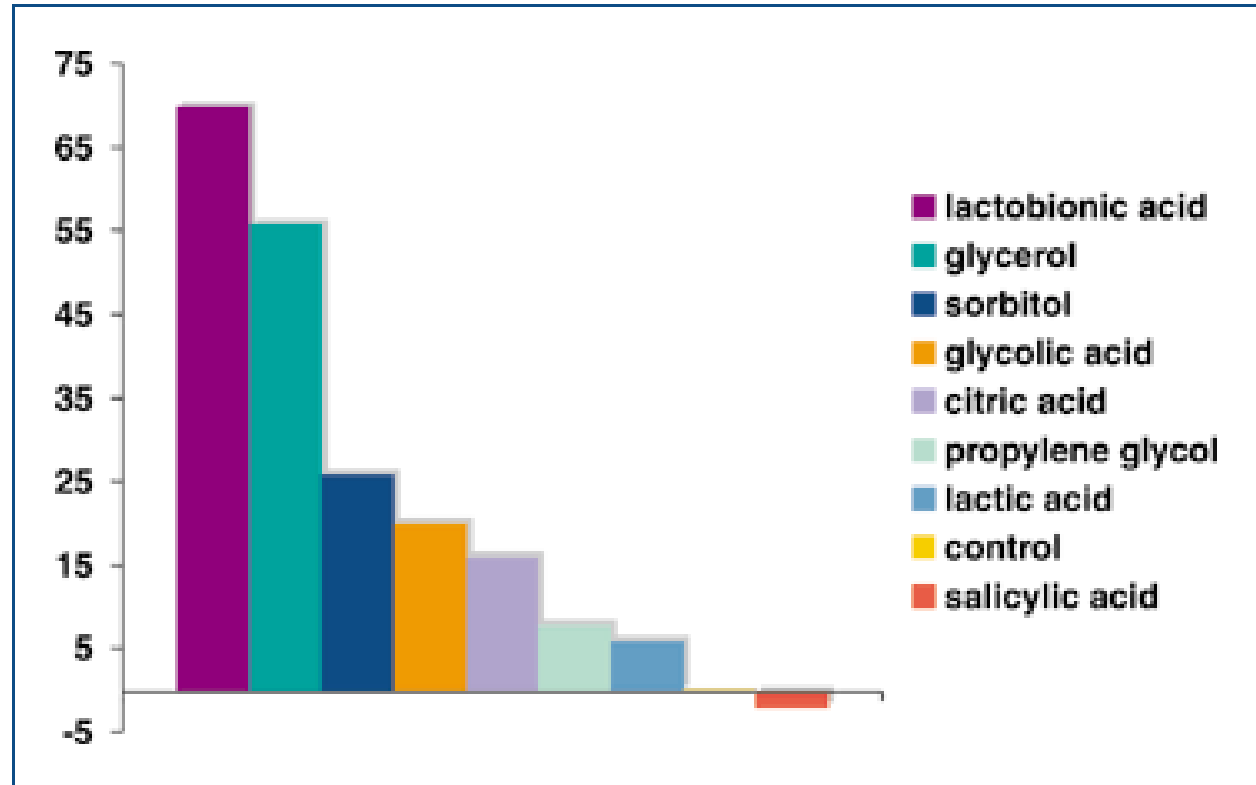
**Weight (g)
of water
retained
per mole**



Test compounds were prepared as 1M aqueous solutions in petri dishes to a total volume of 25 ml. Solutions were oven dried at 100 F until one went to zero moisture. From Green, B.A. et al. 2002

Rate of Water Absorption for Organic Humectants

**Weight (g) of
water
absorbed per
mole of
substance**



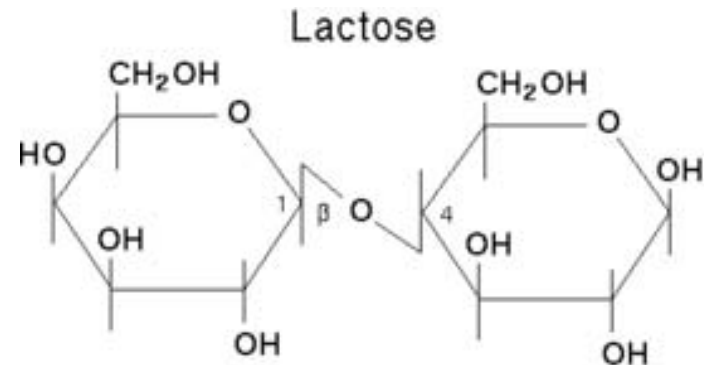
Oven dried samples were exposed to 100% humidity chamber for four hours. Green, B. A. et. al. 2002

Lactobionic Acid Hydrogel

- Natural gel matrix containing water forms on evaporation at room temperature
- Structural resembles a glycoaminoglycan (sulfated polysaccharides seen in connective tissue)
- Gel matrix film contains approximately 14% water
- Does not irritate or harm exposed skin. Non-irritating equivalent to saline solution control

Availability of Aldobionic Acid Dust Control Agents

- The base material, lactose, is a common byproduct of manufacture of cheese
- An estimated 500,000 tons of lactose are produced every year and there is little market for this compound due to its indigestibility
- Conversion of lactose to lactobionic acid can be done inexpensively using chemical oxidation or by bacterial or fungal fermentation
- Continuous, high-yield production makes lactobionic acid a useful humectant for safe dust control



Lactose makes up around 2-8% of milk (by weight). Its systematic name is β -D-galactopyranosyl-(1 \leftrightarrow 4) β -D-glucopyranose.

Summary

- Lactobionic acid the the most hygroscopic organic compound that is currently available.
- Natural gel matrix containing water forms on evaporation at room temperature
- Non-toxic used in food, cosmetics and pharmaceuticals
- Gel matrix film contains approximately 14% water
- Does not irritate or harm exposed skin.
- Can prevent air entrainment of dust without harming plants.

Questions?

